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A Climatic Basis for Planning Military Training Operations and Land Maintenance Activities

by
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Military training exercises are generally scheduled without consideration of annual variations in climatic conditions. Thus, many heavy, mechanized maneuvers are inadvertently conducted when soils are likely to be wet. This causes needless damage to soil and vegetation which reduces the amount of additional training use the land can receive. This report presents the results of an investigation of the utility of long-term precipitation and temperature data for military land-use planning. The probability of weekly precipitation can be determined for each installation and a climate diagram prepared. Military trainers can use graphic presentations of this data to schedule major exercises when the probability of wet soils is low, thus reducing the risk of excessive environmental damage. Similarly, military land managers can use the graphs to identify optimum rehabilitation schedules.

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Military training exercises are generally scheduled without consideration of annual variations in climatic conditions. Thus, many heavy, mechanized maneuvers are inadvertently conducted when soils are likely to be wet. This causes needless damage to soil and vegetation which reduces the amount of additional training use the land can receive. This report presents the results of an investigation of the utility of long-term precipitation and temperature data for military land-use planning. The probability of weekly precipitation can be determined for each installation and a climate diagram prepared. Military trainers can use graphic presentations of this data to schedule major exercises when the probability of wet soils is low, thus reducing the risk of excessive environmental damage. Similarly, military land managers can use the graphs to identify optimum rehabilitation schedules.

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FOREWORD

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This research was performed by the Environmental Division (EN) of the U.S. Army Construction Engineering Research Laboratory (USACERL). Dr. R. K. Jain is Chief of USACERL-EN.

COL Everett R. Thomas is Commander and Director of USACERL. Dr. L.R. Shaffer is Technical Director.

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1 INTRODUCTION

Background

Environmental impacts resulting from armored military training exercises are a growing concern of U.S. Army land management and training personnel. Despite the severity of these impacts, land managers are expected to maintain the natural resources, while military trainers have an obligation to provide a realistic training experience. To ensure the long-term availability of these lands for troop training it is essential to minimize detrimental environmental impacts wherever and whenever possible.

A method has been developed for comparing the capacity of different lands to sustain physical impacts from armored military training.[1] However, little emphasis has been placed on considering annual variations in climatic conditions when scheduling training exercises. As a result, many major military exercises have been scheduled during seasons when soils are likely to be wet, which can lead to excessive vegetation loss, soil compaction, and erosion. This in turn significantly reduces the amount of additional use the land can receive. In addition, lands have often been freed from military use during periods when mitigating land restoration practices have had little chance of success.

Objective

The objective of this research is to reduce land maintenance costs and insure the long-term availability of military training lands by providing military trainers and land managers with installation-specific climatic data that can be used to: (1) identify likely wet periods of the year when heavy, mechanized exercises can seriously impact the soil and vegetation resources; and (2) identify optimum land restoration schedules.

Approach

The objective was achieved by gathering raw temperature and precipitation data from the U.S. Air Force (USAF) Environmental Technical Applications Center (Appendix A). At each locality, usually more than 25 to 30 years of precipitation and temperature data were summarized as described in Chapter 2. Four Army installations in representative U.S. climatic zones were chosen as examples in this report. Appendix B lists other installations for which data are available. USACERL can collect and analyze data for other areas on a reimbursable basis.

Mode of Technology Transfer

This technology will be discussed and transferred at the annual Land Condition-Trend Analysis (LCTA) workshop. Climatic summaries will be prepared for all major installations (Appendix B) and integrated into the Land Condition-Trend Analysis (LCTA) database and the Range Facility Management Support System (RFMSS).

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[1] V. E. Diersing, R. B. Shaw, S. D. Warren, and E. W. Novak, *A User's Guide for Estimating Allowable Use of Tracked Vehicles on Nonwooded Military Training Lands*, Technical Manuscript N-89/09 (USACERL, May 1989).

2 RESULTS AND ANALYSIS

Climate varies among all lands, thus each natural resource manager and trainer must know a unique set of climatic circumstances in order to make informed land management decisions. Proper information can easily make the difference between successful management or failure, so it is critical that all necessary climatic data be readily available. Chief among the climatic parameters for successful land management are temperature and precipitation. These data were analyzed and are presented in tabular and graphic form for four installations in representative climatic zones as "Probability of Weekly Precipitation" and "Climate Diagram." The utility of each kind of summary is listed below.

- Probability of Weekly Precipitation

Military Trainer--Useful to plan water crossing on intermittent streams, select best time for training under a clear sky or cloudy sky, test equipment under wet/dry conditions, minimize the need for rescheduling range activities such as instruction in weapons and equipment use.

Land Manager--Useful to identify the best time for seeding, loosening compacted soils, planting trees, and securing satellite imagery of natural resources.

- Climate Diagram

Military Trainer--Useful for identifying likely changes in trafficability due to annual changes in soil moisture conditions, identifying period of frozen soils, scheduling annual cycling of "invited units."

Land Manager--Useful for estimating damage to natural resources and trails/roads, particularly from heavy mechanized activities, and identifying length of growing season.

Probability of Weekly Precipitation

The probability of weekly precipitation is defined as the likelihood of receiving more than a given amount of total precipitation during a specified 1-week period (Table 1). All probability values are estimates and are usually based on 25 to 30 years of data. Probability values were "smoothed out" using a 3-week moving average. Moving averages, using the mean of the previous, current, and subsequent weekly values for the current value, reduce meaningless fluctuations in the probability curve.

Figures 1 through 4 summarize weekly precipitation at Fort Sill, Oklahoma, Yakima Firing Center, Washington, Fort Wainwright, Alaska, and Fort Chaffee, Arkansas, respectively.

At Fort Sill (Figure 1), the probability of precipitation (all amounts) gradually increases from 1-7 January (1st week) through May 21-27 (21st week). This latter week has the highest probability of precipitation during the year. After May 21-27, precipitation amounts rapidly decrease until July 2-8 (27th week). From this week through July 30-August 5 (31st week) the probability of precipitation remains about the same. Immediately following this period, weekly precipitation increases, reaching a peak about September 17-23 (38th week). After the 38th week, the likelihood of precipitation generally decreases until the end of the calendar year (52nd week).

As an example, the probability of receiving 2.0 in.* or more of precipitation is greater than 25 percent each of the 2 weeks from 21 May through June 3 (weeks 21 and 22). In other words, based upon the

*1 in. = 25.4 mm

estimate, 2.0 in. or more of precipitation will fall during each of these weeks in 1 of every 4 years. In comparison, 5 weeks later, the likelihood has dropped to about 5 percent and remains less than 8 percent through August 6-12 (32nd week); i.e., on the average, in only about 1 of every 13 years will 2.0 in. or more of precipitation occur during this period.

Table 1

Calendar of 1-Week Periods Corresponding to the 52-weeks Shown in Figures 2 Through 5

Week	Start Date	End Date	WEEK	Start Date	End Date
1	JAN 01	JAN 07	28	JUL 09	JUL 15
2	JAN 08	JAN 14	29	JUL 16	JUL 22
3	JAN 15	JAN 21	30	JUL 23	JUL 29
4	JAN 22	JAN 28	31	JUL 30	AUG 05
5	JAN 29	FEB 04	32	AUG 06	AUG 12
6	FEB 05	FEB 11	33	AUG 13	AUG 19
7	FEB 12	FEB 18	34	AUG 20	AUG 26
8	FEB 19	FEB 25	35	AUG 27	SEP 02
*9	FEB 26	MAR 04	36	SEP 03	SEP 09
10	MAR 05	MAR 11	37	SEP 10	SEP 16
11	MAR 12	MAR 18	38	SEP 17	SEP 23
12	MAR 19	MAR 25	39	SEP 24	SEP 30
13	MAR 26	APR 01	40	OCT 01	OCT 07
14	APR 02	APR 08	41	OCT 08	OCT 14
15	APR 09	APR 15	42	OCT 15	OCT 21
16	APR 16	APR 22	43	OCT 22	OCT 28
17	APR 23	APR 29	44	OCT 29	NOV 04
18	APR 30	MAY 06	45	NOV 05	NOV 11
19	MAY 07	MAY 13	46	NOV 12	NOV 18
20	MAY 14	MAY 20	47	NOV 19	NOV 25
21	MAY 21	MAY 27	48	NOV 26	DEC 02
22	MAY 28	JUN 03	49	DEC 03	DEC 09
23	JUN 04	JUN 10	50	DEC 10	DEC 16
24	JUN 11	JUN 17	51	DEC 17	DEC 23
25	JUN 18	JUN 24	**52	DEC 24	DEC 31
26	JUN 25	JUL 01			
27	JUL 02	JUL 08			

*8 Day Period During Leap-Year
**8 Day Period

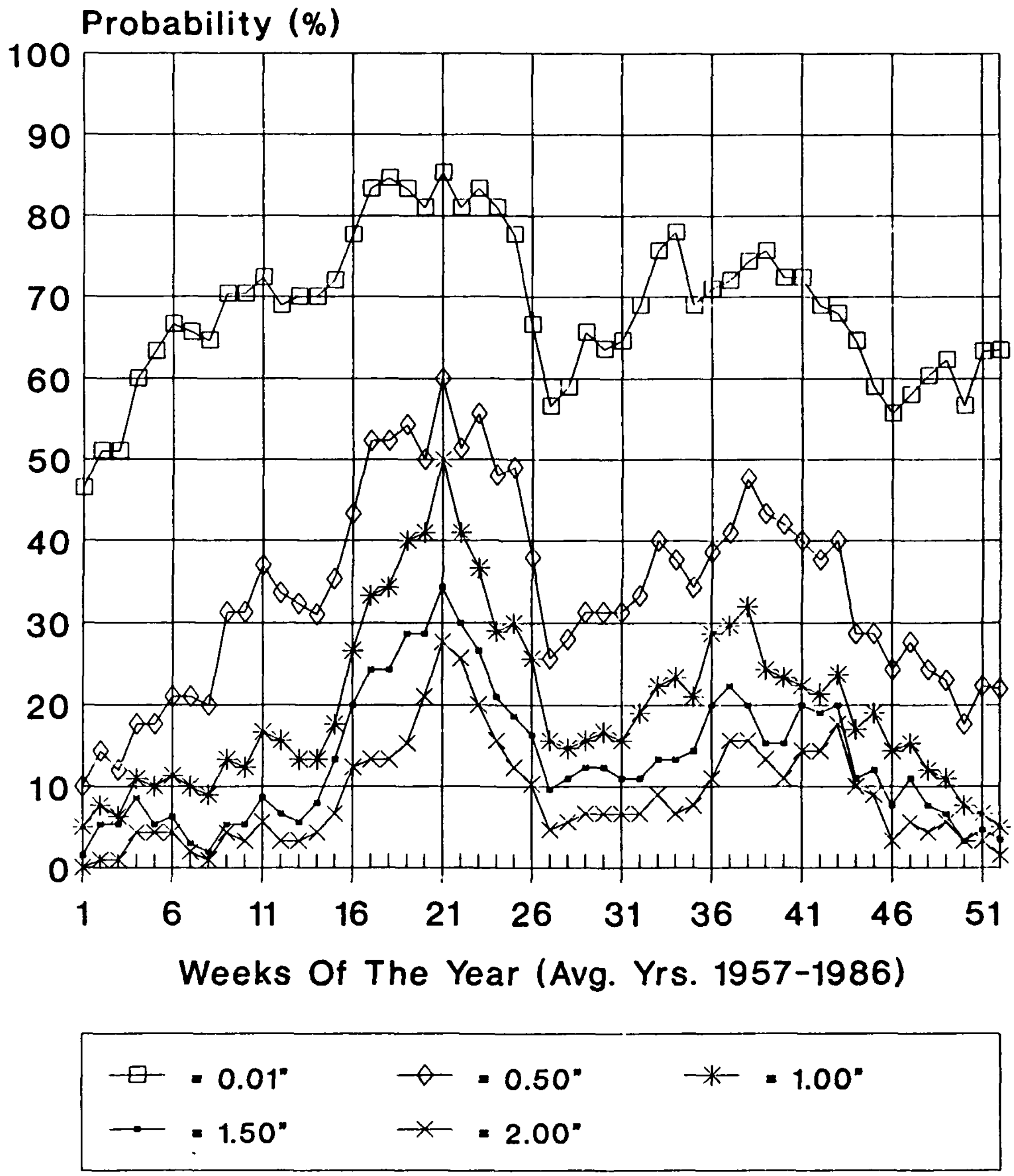


Figure 1. **Probability of weekly precipitation at Fort Sill, Oklahoma, exceeding 0.01 (trace), 0.5, 1.0, 1.5, and 2.0 in.**

At the Y ̷akima Firing Center, Washington (Figure 2), the probability of precipitation is relatively high at the beginning of the year then gradually decreases until July 23-29 (30th week). After July 29 the likelihood of precipitation gradually increases, reaching a peak at the end of the calendar year (week 52).

Precipitation at Fort Wainwright, Alaska (Figure 3), is low. From the beginning of the year through about May 28-June 3 (22nd week), the probability for precipitation amounts 1.0 in. or greater is approximately zero. However, the probability of 0.5 in. or more starts increasing about April 23-29 (17th week) and rapidly increases through about July 30-August 5 (31st week).

The probability of precipitation at Fort Chaffee, Arkansas (Figure 4), is generally high. Probabilities at the beginning of the calendar year are relatively low, then rapidly increase to about April 23-29 (17th week). After April 29, probability values rapidly decrease until July 9-15 (28th week). After this date, the likelihood of precipitation remains about the same until August 27-September 2 (35th week). Beginning with the week of September 3-9 (36th week) there is a slight increase in the probability of heavier amounts of precipitation, peaking in about late October or early November (weeks 43-45). Probability values generally decrease from then until the end of the year.

Climate Diagram

Soil moisture is more than a function of the amount of precipitation received. Temperature greatly affects the time that soils will remain wet. The purpose of the Climate Diagram is to: (1) relate temperature and precipitation such that average annual soil moisture conditions are represented, (2) graphically illustrate length of the growing season and period of frozen soils, and (3) characterize average monthly precipitation and temperature (tabular data).

An ecological climate diagram[2] can be used to improve the Army land management process and reduce the risk of environmental damage. An interpretation guide to climate diagrams is shown in Figure 5. A climatic diagram is constructed by plotting average monthly temperature (°C) and average monthly precipitation (millimeters) against an annual time scale on a common graph. Temperature and precipitation are scaled such that 1 °C = 2 mm of precipitation. A comparison of the temperature and precipitation curves provides insight into the soil water balance. If the temperature curve is above the precipitation curve, conditions are on the arid end of the spectrum; if the precipitation curve is above the temperature curve, conditions are more humid. Vertical distance between the curves represents the intensity of humid or arid conditions and horizontal distance represents the duration of these conditions.

To enhance the climatic diagrams for military scheduling purposes, two horizontal lines are added (Figure 5). The top line is drawn at 10 °C. The period during which temperatures are above this line corresponds approximately to the growing season, assuming that moisture is adequate.

The bottom horizontal line represents the freezing point (0 °C). All temperatures below freezing may result in frozen soils if moisture is present. However, soils may not be well frozen until the average temperature is near -2 to -4 °C. Large-scale armored maneuver exercises can be conducted when the soils are frozen with little damage to the soil structure.

The climate diagram of Fort Sill, Oklahoma (Figure 6), illustrates that winters are mild and summers are hot. Humid conditions occur throughout the year (diagonal-lined area) except from mid-July to early August, which is slightly arid (stippled area). The humid period is extremely intense during the latter half of spring (late April to early June) when temperatures are relatively low and precipitation is highest. A secondary intense humid period occurs in early fall (late September to early October). Major military training exercises should be reduced during late spring and early fall due to the very high probability

[2] H. Walter, *Vegetation of the Earth and Ecological Systems of the Geo-Biosphere* (Springer-Verlag, Berlin, Germany, 1985), 318 pp.

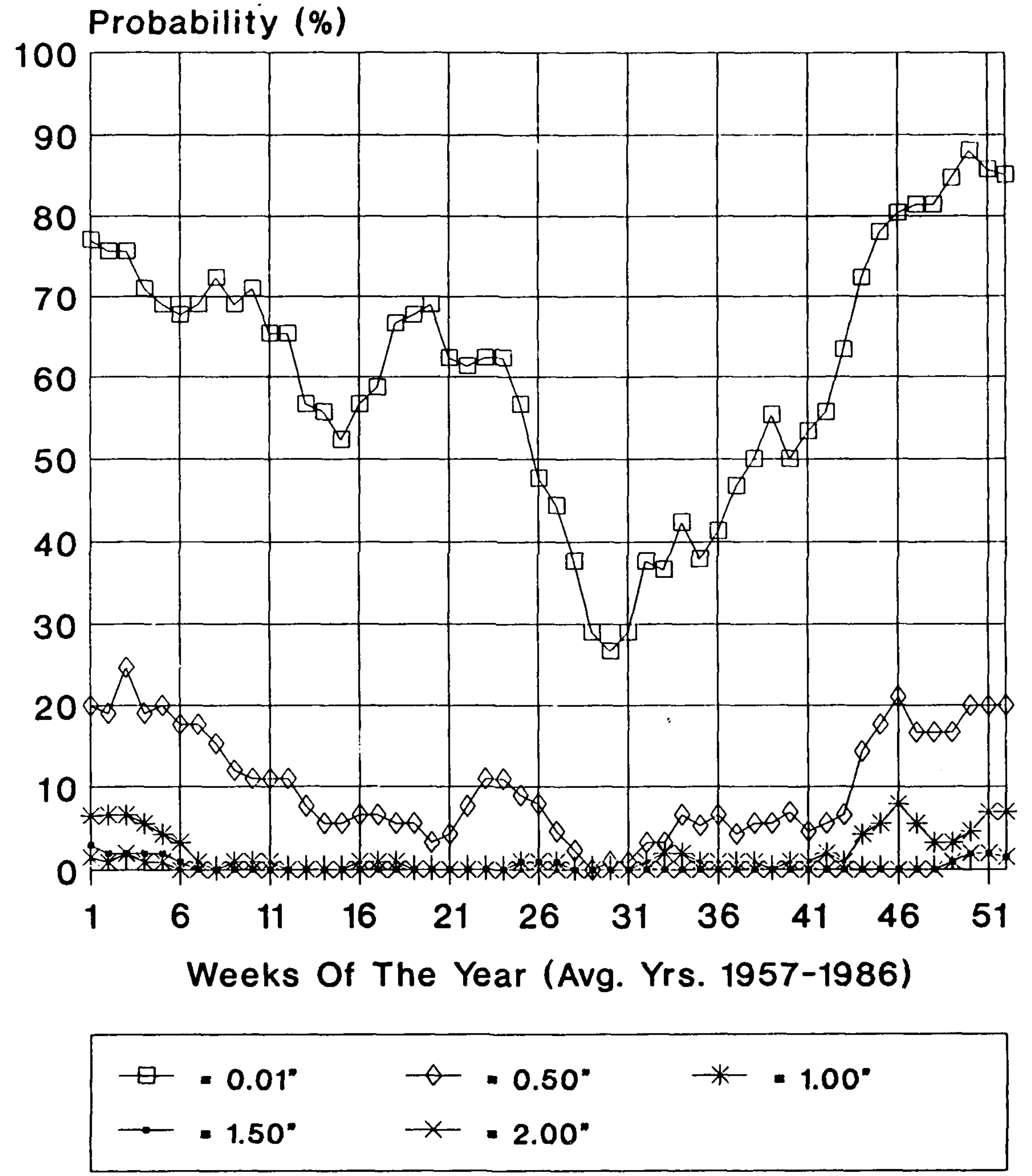


Figure 2. Probability of weekly precipitation at Yakima Firing Center, Washington, exceeding 0.01 (trace), 0.5, 1.0, 1.5, and 2.0 in. (Data from the town of Yakima.)

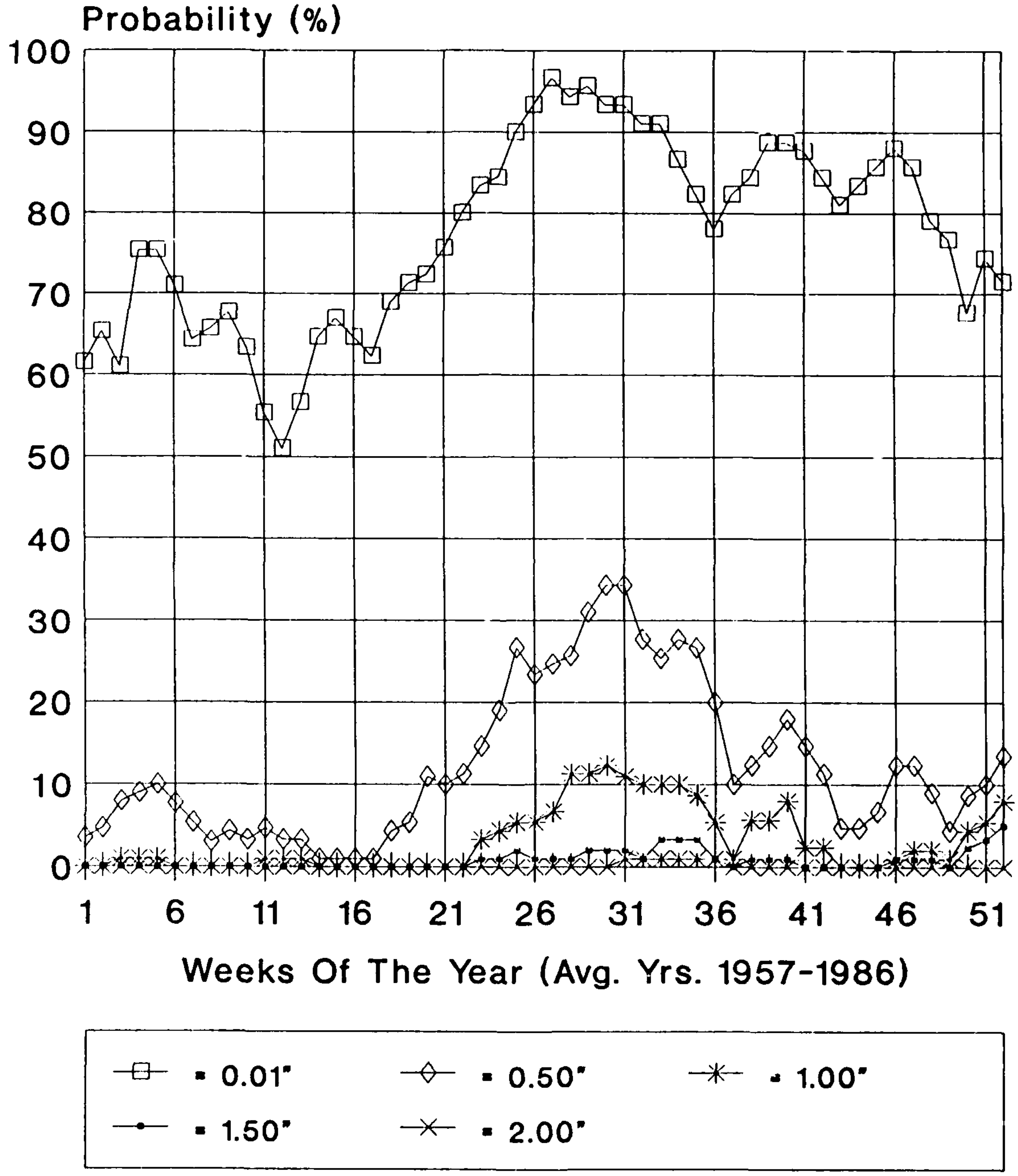


Figure 3. Probability of weekly precipitation at Fort Wainwright, Alaska, exceeding 0.01 (trace), 0.5, 1.0, 1.5, and 2.0 in. (Data from Fairbanks.)

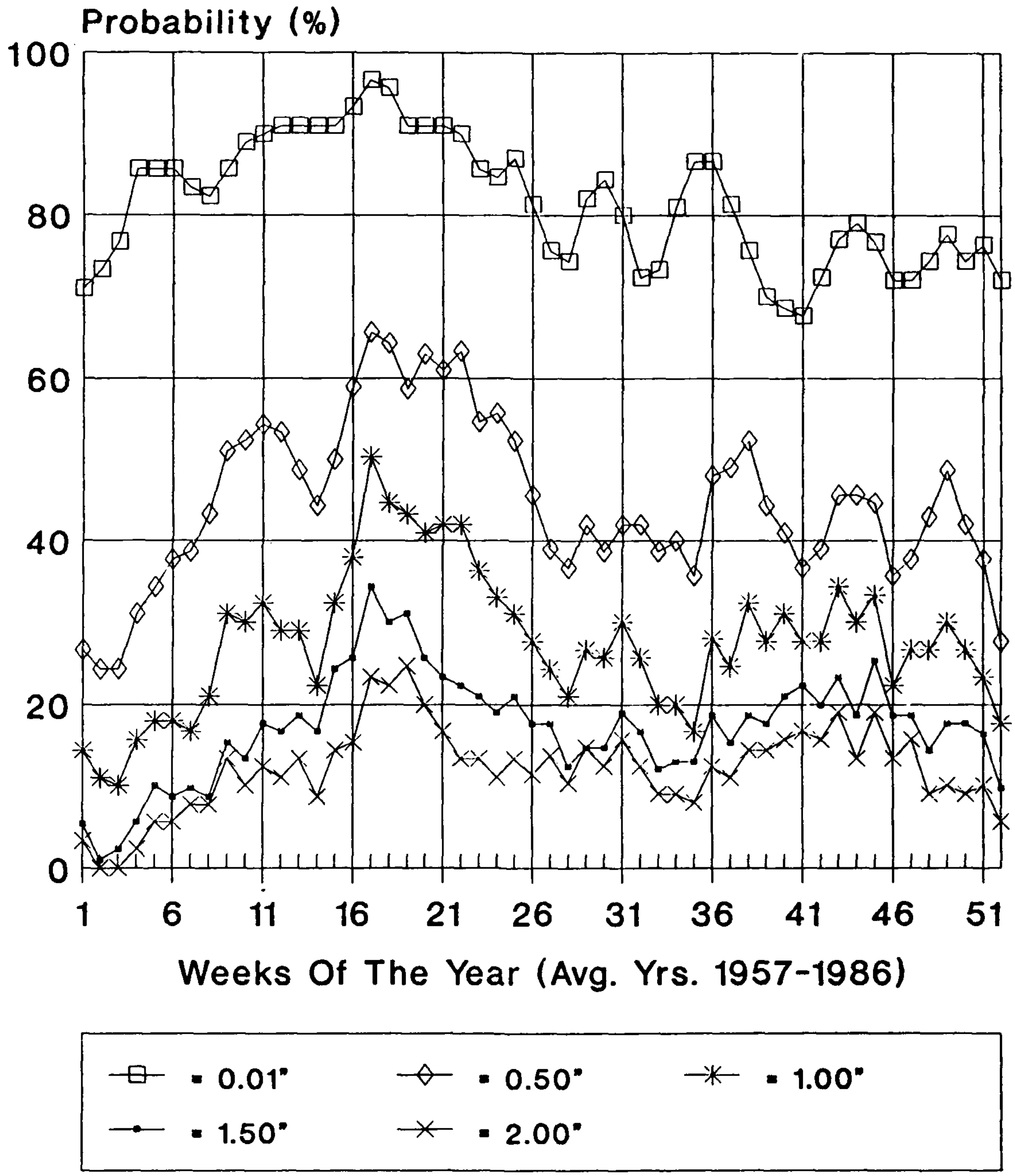
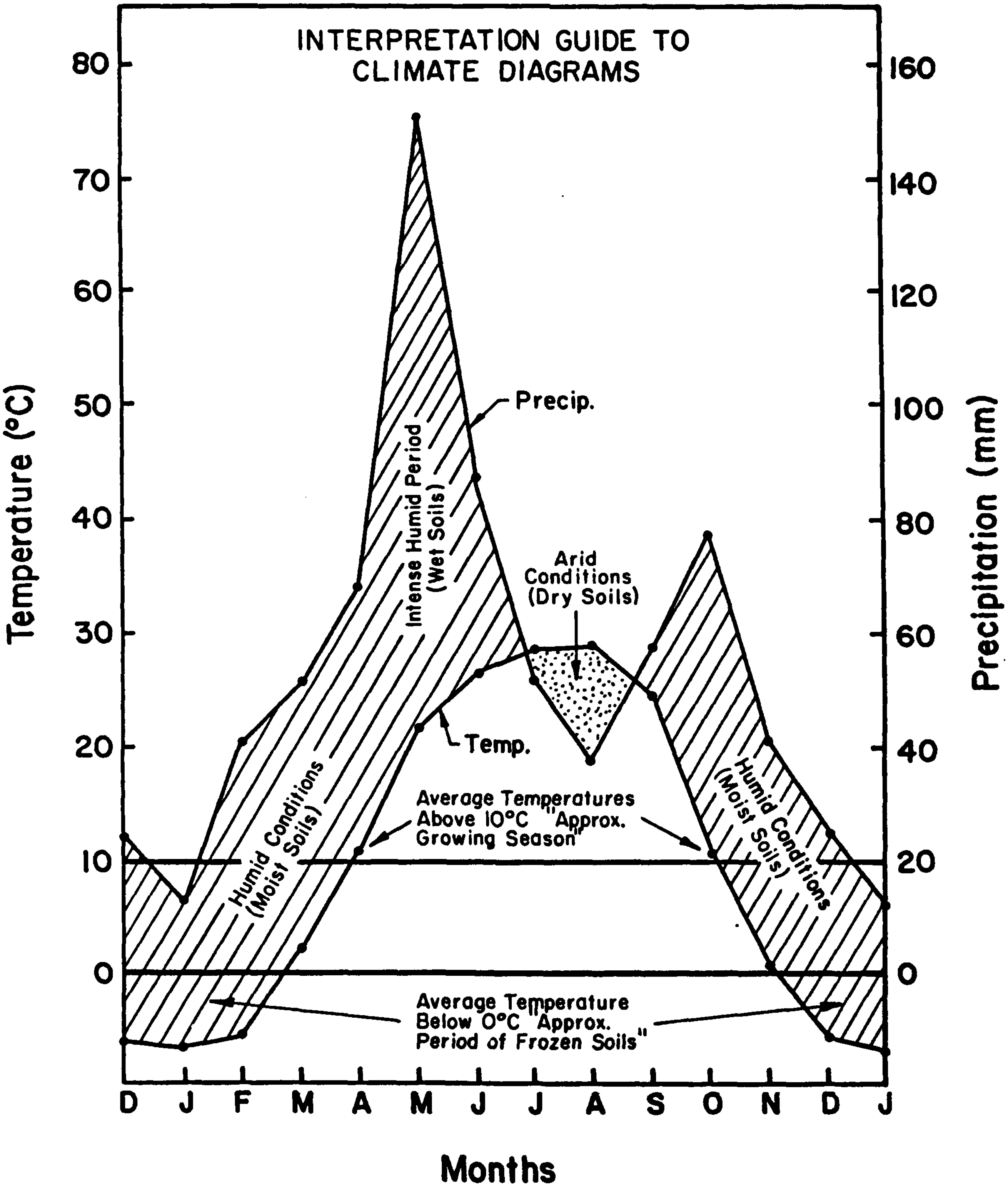
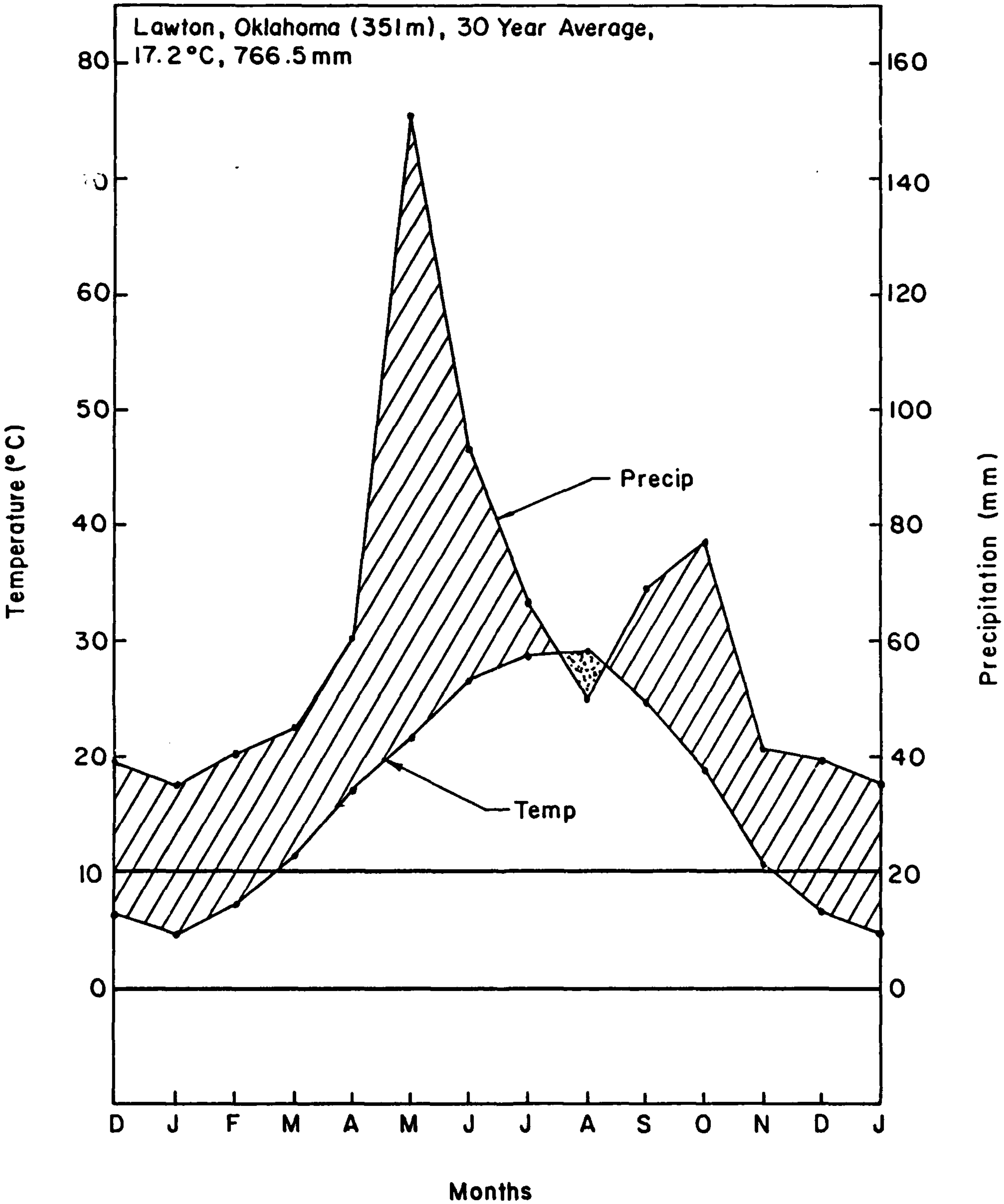


Figure 4. Probability of weekly precipitation at Fort Chaffee, Arkansas, exceeding 0.01 (trace), 0.5, 1.0, 1.5, and 2.0 in. (Data from Fort Smith.)



In general, soil moisture increases as the precipitation curve exceeds the temperature curve. Stipled areas are relatively arid and diagonal lined areas more humid. Temperatures above 10°C approximate the growing season and below 0 °C, frozen soils.

Figure 5. Interpretation guide to climate diagrams.



The legend within the figure is location, elevation (in parentheses), 30-year average annual temperature, and average annual precipitation.

Figure 6. Climate diagram for Fort Sill, Oklahoma. (Data from Lawton, which is adjacent to Fort Sill.)

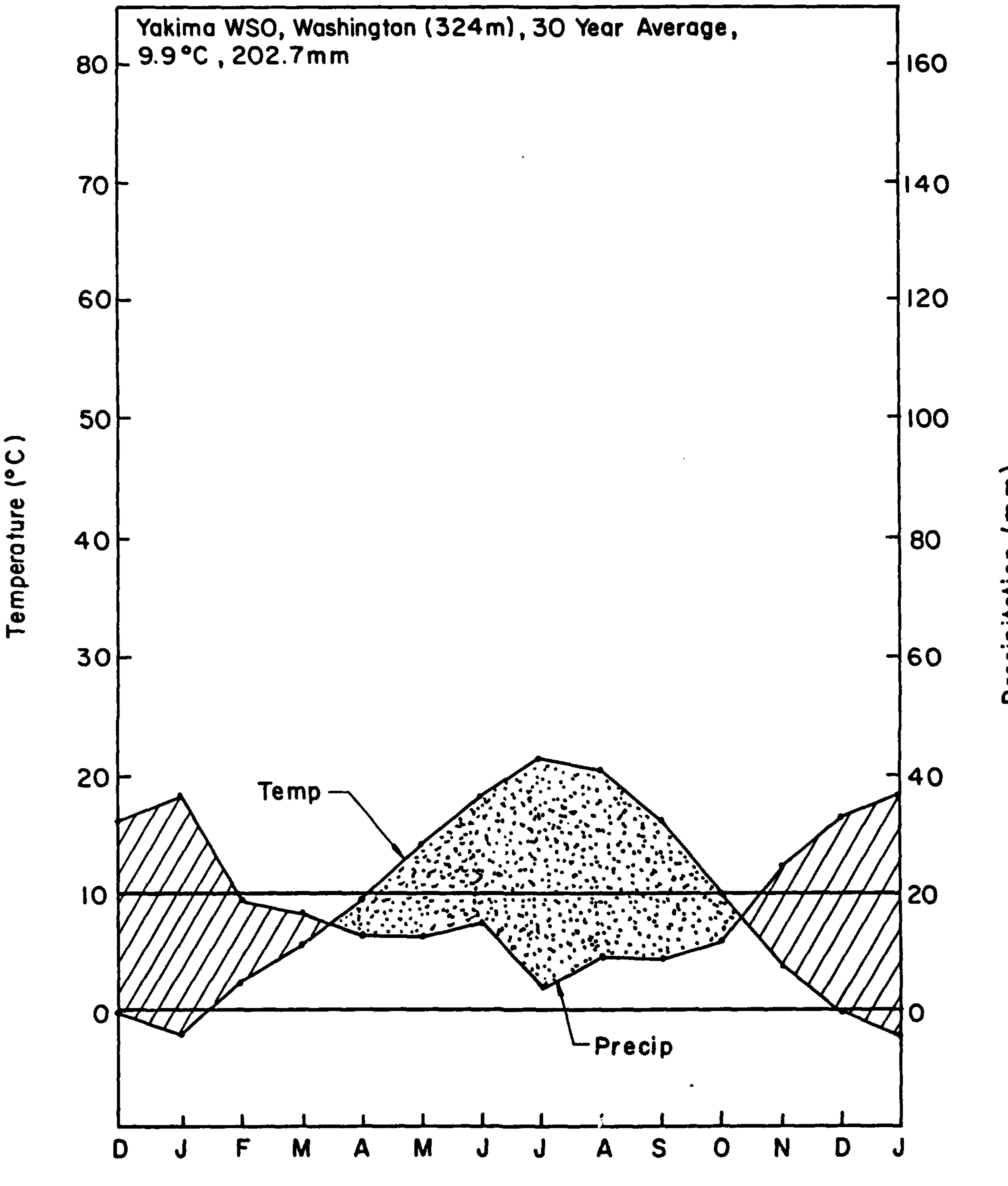
that the soils will be wet and, therefore, susceptible to damage. Optimally, training should be scheduled from July to mid-August when the likelihood of the soils being dry is high. A secondary period for training appears to be in late winter and early spring (late February through March) when the probability of precipitation is relatively low and temperature is increasing. If damage occurs during this period, the length of time before vegetation has the opportunity to regrow is minimized.

At Fort Sill, the growing season occurs from about early March to late October. Within this period, soils have the highest probability of being moist from early March to early June and again from late August through mid-October. Seeding of damaged lands would have the greatest probability of success during these periods. Training lands requiring such repair should not be scheduled for use. The soils do not freeze at Fort Sill.

The climate diagram of the Yakima Firing Center, located in southern Washington (Figure 7), shows that the summer is hot and dry and the winter cold and wet. The humid period occurs from early October to mid-March, and the dry period occurs from mid-March to early October. Training should be scheduled during the most intense portion of the dry season, particularly from mid-June to early September. Training should be minimized during the humid winter period, except possibly from mid-December to early January when the soils may be frozen. Seeding has the highest probability of success in March and October when the soils are moist. The Yakima Firing Center receives much of its precipitation as snow; thus in February and March, during snowmelt, the soils are probably wetter than indicated by the climatic diagram.

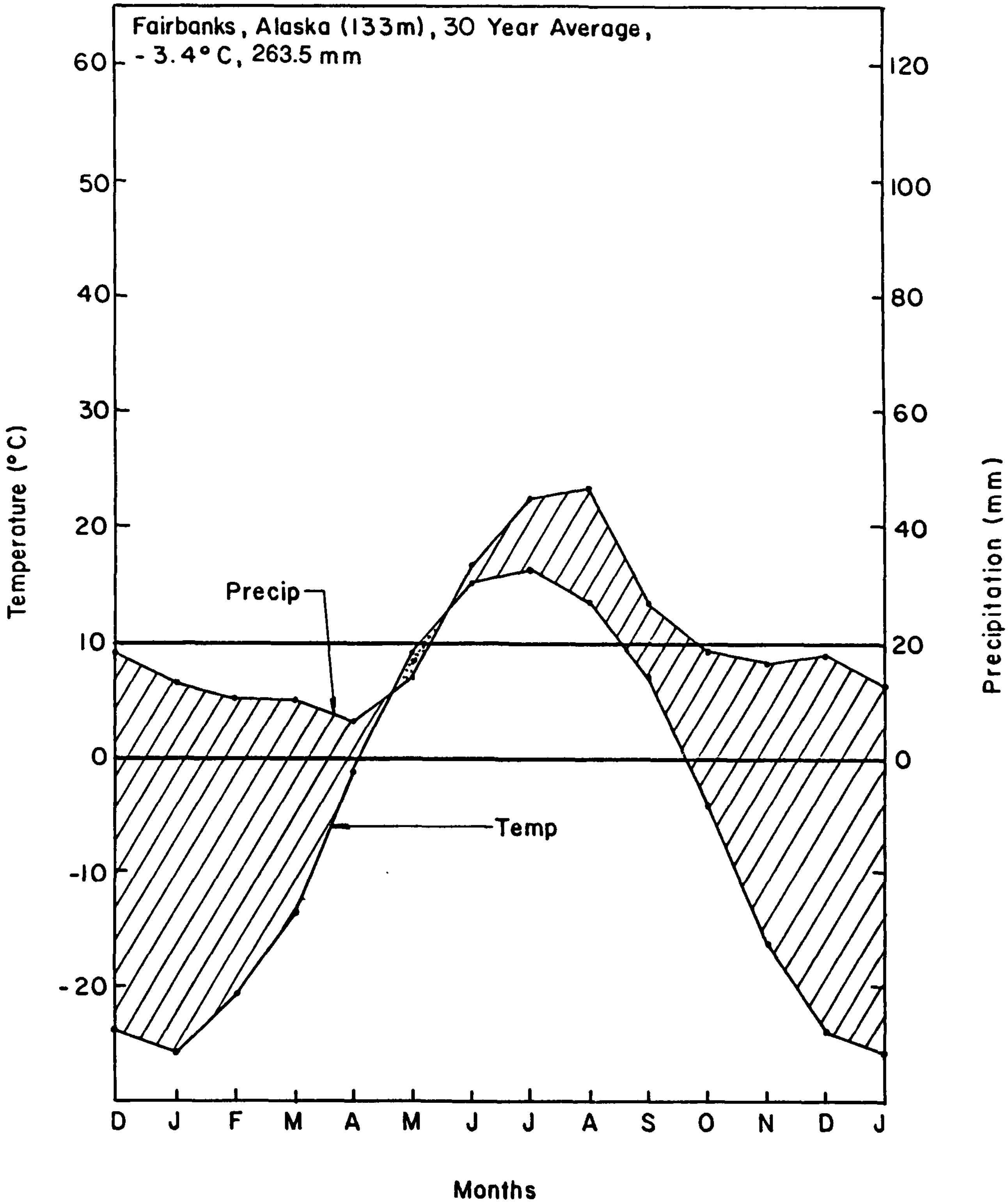
The climate diagram for Fort Wainwright, Alaska (Figure 8), illustrates that: (1) the humid period occurs throughout the year except during late April and early May, (2) the soils are frozen from late September to April, and (3) the growing season is short, occurring from early May to mid-August. Based on this information, optimum times for training exercises would be when the soils are frozen, particularly from mid-October to mid-March, and possibly in early May during the latter part of the dry season. Fort Wainwright, like the Yakima Firing Center, receives much of its total precipitation as snow. During snowmelt in April and early May, the soils may be saturated even though the climatic diagram indicates that April is slightly humid to slightly arid.

The climate diagram (Figure 9) for Fort Chaffee, Arkansas, illustrates that the climate is mild and precipitation is high. The humid period is year-long, soils are never frozen, and the growing season extends from March through October. The best time for scheduling training exercises would be from late June to early August, which represents the lowest intensity of the humid period. A secondary scheduling period may be during late December and early January, which is about 6 to 8 weeks before the growing season. Thus, the length of time before vegetation has the opportunity to regrow is minimized.



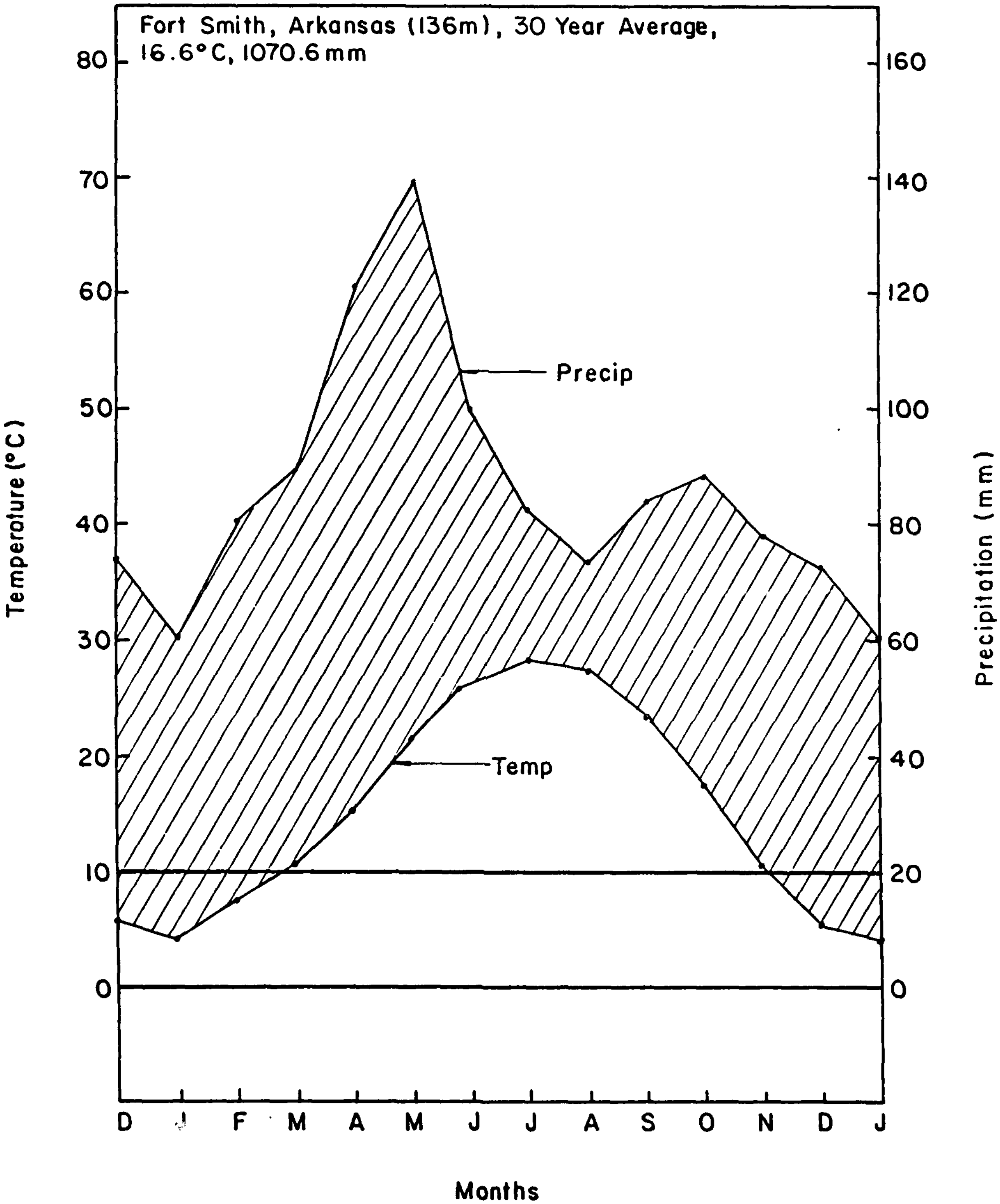
The legend within the figure is location, elevation (in parentheses), 30-year average annual temperature, and average annual precipitation.

Figure 7. Climate diagram for Yakima Firing Center (YFC), Washington. Data from Yakima, which is adjacent to YFC.



The legend within the figure is location, elevation (in parentheses), 30-year average annual temperature, and average annual precipitation.

Figure 8. Climate diagram for Fort Wainwright, Alaska. Data from Fairbanks, which is near Fort Wainwright.



The legend within the figure is location, elevation (in parentheses), 30-year average annual temperature, and average annual precipitation.

Figure 9. Climate diagram for Fort Chaffee, Arkansas. Data from Fort Smith, which is adjacent to Fort Chaffee.

3 SUMMARY AND RECOMMENDATIONS

This report has presented graphs showing the probability of weekly precipitation and ecological climatic diagrams for Army installations at several representative locations in the United States. This information can be used for scheduling military training exercises to reduce the risk of environmental damage and choosing optimum times for land rehabilitation. In areas receiving considerable snowfall, the climatic diagram may not account for high soil moisture during snowmelt. If training must be scheduled during a humid period, the period of potential erosion can be minimized by scheduling the exercise when there is the shortest length of time before the next growing season.

On large training areas, weather stations, including soil moisture probes, should be established to monitor precipitation and soil moisture conditions for military trainers and land managers on a day-to-day basis.

APPENDIX A:

PRECIPITATION AND TEMPERATURE DATA USED TO CONSTRUCT THE CLIMATE DIAGRAMS

Lawton, Oklahoma. Elevation 1150 ft or 351 m.
Averages Based on Data From 1931-1960
Longitude W 98 27' Latitude N 34 37'

Month	Temperature		Precipitation	
	F	C	in.	mm
January	40.7	4.9	1.39	35.3
February	45.1	7.3	1.58	40.1
March	52.3	11.4	1.78	45.2
April	62.4	17.0	2.37	60.2
May	70.4	21.5	5.95	151.1
June	79.5	26.6	3.67	93.2
July	83.6	28.9	2.61	66.3
August	83.7	29.0	1.96	49.8
September	76.1	24.7	2.71	68.8
October	64.8	18.4	3.01	76.5
November	50.9	10.6	1.62	41.1
December	43.1	6.2	1.53	38.9
Mean Annual Temp.	62.7	17.2		
Average Annual Ppt.			30.18	766.5

Yakima, Washington. Elevation 1064 ft or 324 m.
Averages Based on Data From 1951-1980
Longitude W 120 32' Latitude N 46 34'

Month	Temperature		Precipitation	
	F	C	in.	mm
January	28.2	-2.1	1.44	36.6
February	36.1	2.3	0.74	18.8
March	41.9	5.5	0.65	16.5
April	49.2	9.6	0.50	12.7
May	57.3	14.2	0.48	12.2
June	64.5	18.2	0.60	15.2
July	70.4	21.5	0.14	3.6
August	68.6	20.5	0.36	9.1
September	60.9	16.2	0.33	8.3
October	49.9	10.0	0.47	11.9
November	38.2	3.5	0.97	24.6
December	31.5	-0.3	1.30	33.0
Mean Annual Temp.	49.7	9.9		
Average Annual Ppt.			7.98	202.7

Fairbanks, Alaska. Elevation 436 ft or 133 m.
Averages Based on Data From 1951-1980
Longitude W 147 52' Latitude N 64 49'

Month	Temperature F	Temperature C	Precipitation in.	Precipitation mm
January	-12.8	-25.1	0.53	13.5
February	-4.0	-20.2	0.42	10.7
March	8.5	-13.2	0.40	10.2
April	30.2	-1.0	0.27	6.9
May	48.2	9.1	0.57	14.5
June	59.3	15.3	1.32	33.5
July	61.5	16.5	1.77	45.0
August	56.6	13.8	1.86	47.2
September	44.9	7.2	1.09	27.7
October	25.0	-3.9	0.74	18.8
November	3.9	-15.7	0.67	17.0
December	-10.1	-23.6	0.73	18.5
Mean Annual Temp.	25.9	-3.4		
Average Annual Ppt.			10.37	263.5

Fort Smith, Arkansas. Elevation 447 ft or 136 m.
Averages Based on Data from 1941-1970
Longitude W 94 22' Latitude N 35 20'

Month	Temperature F	Temperature C	Precipitation in.	Precipitation mm
January	39.2	4.0	2.38	60.5
February	43.4	6.4	3.20	81.3
March	51.0	10.6	3.52	89.4
April	62.5	17.1	4.74	120.4
May	70.6	21.6	5.48	139.2
June	78.3	25.9	3.93	99.8
July	82.3	28.2	3.24	82.3
August	81.5	27.7	2.91	73.9
September	74.1	23.6	3.31	84.1
October	63.4	17.6	3.47	88.1
November	51.0	10.6	3.08	78.2
December	41.6	5.4	2.89	73.4
Mean Annual Temp.	61.7	16.6		
Average Annual Ppt.			42.15	1070.6

APPENDIX B:

INSTALLATIONS FOR WHICH CLIMATE SUMMARIES ARE CURRENTLY AVAILABLE FROM USACERL

Installation (Weather Station)	Probability of Weekly Precipitation	Climate Diagram
White Sands Missile Range, NM		
Carrizozo	NO	YES
White Sands Nat. Monument	YES	YES
State University	NO	YES
Elephant Butte Dam	NO	YES
Bosque Del Apache	NO	YES
Yakima Firing Center, WA		
Yakima	YES	YES
Moxee City	YES	YES
Quincy	YES	YES
Cle Elm	YES	YES
Othello	NO	YES
Sunnyside	NO	YES
Wapato	NO	YES
Fort Wainwright, AK		
Fairbanks	YES	YES
Tanana	YES	YES
College Observatory	YES	YES
McKinley Park	YES	YES
Fort Sill, OK		
Fort Sill	YES	NO
Wichita Mt. W.L. Ref.	NO	YES
Anadarko	NO	YES
Lawton	NO	YES
Duncan	NO	YES
Fort Riley, KS		
Fort Riley	YES	NO
Wakefield	NO	YES
Manhattan	NO	YES
Clay Center	NO	YES
Abilene	NO	YES

APPENDIX (cont.)

Installation (Weather Station)	Probability of Weekly Precipitation	Climate Diagram
Pohakuloa Training Area, HI		
Ahuaumi	NO	NO
Halepohaku	YES	NO
Kulani Mauka	YES	YES
PUU WAA WAA	YES	NO
Fort McClellan, AL		
Talladega	YES	YES
Anniston	YES	YES
Fort Leonard Wood, MO		
Fort Leonard Wood	YES	NO
Waynesville	NO	YES
Lebanon	NO	YES
Salem	NO	YES
Licking	NO	YES
Fort Knox, KY		
Bardstown	NO	YES
Shepherdsville	NO	YES
Leitchfield	NO	YES
Louisville	NO	YES
Fort Irwin, CA		
Randsburg	YES	YES
Tehachapi	YES	YES
Barstow	YES	YES
Daggett FAA AP.	YES	YES
Fort Hood, TX		
Fort Hood	YES	YES
Gatesville	YES	YES
Temple	YES	YES
Lampasas	YES	YES
Fort Chaffee, AR		
Subiaco	YES	YES
Fort Smith	YES	YES
Ozark	NO	YES

APPENDIX (cont.)

Installation (Weather Station)	Probability of Weekly Precipitation	Climate Diagram
Fort Carson, CO		
Colorado Springs	YES	YES
Pueblo	YES	YES
Canon City	YES	YES
Pinon Canyon Maneuver Site, CO		
Rocky Ford	NO	YES
Walsenburg	NO	YES
Springfield	NO	YES
Trinidad	NO	YES
Camp Ripley, MN		
Brainerd	YES	YES
Little Falls	YES	YES
Gull Lake Dam	YES	YES
Long Prairie	YES	YES
Melrose	YES	YES
Blanchard	YES	YES
Fort Ripley	YES	YES
Orchard Training Area, ID		
Boise	YES	YES
Lucky Peak Dam	YES	YES
Bruneau	YES	YES
Glenns Ferry	YES	YES
Grand View 2W	YES	YES
Kuna 2 NNE	YES	YES
Mountain Home	YES	YES
Swan Falls Power House	YES	YES
Dugway Proving Grounds, UT		
Callao	YES	YES
Dugway	YES	YES
Fish Springs Refuge	YES	YES
Gold Hill	YES	YES
Lucin	YES	YES
Wendover AUTOB	YES	YES

ENR Team Distribution

Chief of Engineers
ATTN: CEHEC-IM-LP (2)
ATTN: CEHEC-IM-LH (2)
ATTN: CECW-RR (2)
ATTN: CEMP-EI (2)
ATTN: CEMP-ET (2)
ATTN: CEMP-ZM (2)
ATTN: DAEN-ZCE (9)
ATTN: CERD-L

CEHSC 22060
ATTN: CEHSC-FB
ATTN: CEHSC-FN

US Army Engineer District
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Baltimore 21203
Norfolk 23510
Savannah 31402
Mobile 36628
Kansas City 64106
Omaha 68102
Fort Worth 76102
Los Angeles 90053
Sacramento 95814
Alaska 99506
ATTN: Chief, NCCPE-PES
Chicago 60606

US Army Engineer Division
New England 02254
ATTN: Regulatory Functions
Huntsville 35807
ATTN: HNDAD-O
North Central 60605
ATTN: Chief, Engr Div

Indicated Fac. in DA PAM 210-1 (68)

US Army Engr Command, Europe
APO New York, NY 09403

6th Infantry Div (LIGHT)
ATTN: AFYR-FG-DE 98733
ATTN: AFVR-DE-PSE 99505

7th US Army 09407
ATTN: AETTM-DTT-MG-EH

172nd Infantry Brigade (AK) 98733
ATTN: AFZT-FG-EH

US Army Health Services 78234
ATTN: HSCO-MR

ARRCOM 61299
ATTN: DRSAR-ISE

AMC 22333
ATTN: AMCEN-A (2)

Ft. Bustis, VA 23604
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ATTN: ATIC-SP
ATTN: ATZF-EHW

US Military Academy 10996
ATTN: Dept of Mechanics
ATTN: Library
ATTN: Envr. Office

The Army Library (ANRAL-R) 20310
ATTN: Army Studies Section

National Guard 20310
ATTN: NGB-ARO-AM

CERCOM 07703
ATTN: DRSEL-PL-ST

Defense Logistics Agency 22314
ATTN: DLA-OSC (3)
ATTN: DLA-WS (2)

Depot Systems Command 17201
ATTN: DRSDS-S

US Army HQ FORSCOM 30330
ATTN: AFEN-EQ (4)
ATTN: Fac Engr/Envr Office

Insts and Services Activities 61299
ATTN: DRCIS-RI

USA Intelligence and Security 22212
ATTN: IALOG-IF

TSARCOM 63120
ATTN: DRSTS-B

Ft. Belvoir, VA 22060
ATTN: ATSEN-DT-LD (2)
ATTN: Archives Section/Bldg 270
ATTN: CECC-R

Ft. Lee, VA 23801
ATTN: AMXMC-MR-D (5)

Ft. Wainwright, AK 99703
ATTN: AFVR-FW-DE-EN

US Naval Academy 21412
ATTN: Political Sci Dept

Ft. Buchanan 00934
ATTN: Envr/Energy Ofc

Ft. Monroe, VA 23651
ATTN: ATEN-ZXA (3)
ATTN: ATEN-FN (H)

Army Depots
Seneca 14541
ATTN: SDSSE-ADE
New Cumberland 17070
ATTN: Fac Engr/Envr Ofc
Letterkenny 17201
ATTN: Fac Engr/Envr Ofc
Tobyhanna 18466
ATTN: SDSTO-AF-E
Scranton 18505
ATTN: Fac Engr/Envr Ofc
Anniston 36201
ATTN: SDSAN-DAS-FE
Memphis 38114
ATTN: DDMT-WI
Lexington-Blue Grass 40111
ATTN: SDSLB-ASF-C
Red River 75501
ATTN: SDSRR-S
Pueblo Army Depot 81001
ATTN: Fac Engr/Envr Ofc
Tooele 84074
ATTN: SDSTE-FW
ATTN: SDSPU-A
ATTN: SDSTE-UM
ATTN: SDSTE-ASF-E
Ogden 84402
ATTN: Fac Engr/Envr Ofc
Navajo 86015
ATTN: AZXA-AS-F
Sharpe 95331
ATTN: SDSSH-AFE-E
ATTN: SDSSH-ASF
Sierra 96113
ATTN: SDSSI-FE

Arsenals
Pine Bluff 71602
ATTN: SARPB-ETD
Picatinny 07801
ATTN: SMCAR-ISE-N

Aberdeen Proving Ground, MD 21010
ATTN: STEAP-FE-M
ATTN: STEAP-FE-E
ATTN: NGB-ARI-E
ATTN: DRDAR-CLT-E

Dugway Proving Ground 84022
ATTN: STEDP-PO
ATTN: STEDP-MT-L-E (2)

Electronic Proving Ground 85613
ATTN: LD (FAC MAG)

Jefferson Proving Ground 47250
ATTN: STEJP-DEH

Yuma Proving Ground 85365
ATTN: STEYP-FL
ATTN: STEYP-FE-P

Army Ammunition Plants
Holston 37660
ATTN: SMCHO-EN
Milan 38358
ATTN: SARMI-EN
Mississippi 39529
Indiana 47111
ATTN: SMCIN-EN
Crane 47522
ATTN: Fac Engr/Envr Ofc
Iowa 52638
ATTN: SMCIO-EN
Kansas City 67357
ATTN: SMCK-CE
McAlester 74501
ATTN: Fac Engr/Envr Ofc
Riverbank 95367
ATTN: Fac Engr/Envr Ofc

Medical Bioengr Res & Dev Lab 21701
ATTN: Envr Protection & Res Div

Army Research Office 27709
ATTN: SLCRO-GS

Director, USAWES 39180
ATTN: WESER

US Army Garrison-Panama 34004
ATTN: SOGA-EHE

Tank-Automotive R&D Command 48090
ATTN: DRDTA-J
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ATTN: DRSTA-SP

Armament R&D Command 07801
ATTN: DRDAR-LCM-S

Belvoir R&D Command 22060
ATTN: STRBE-U
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Electronics R&D Command 20783
ATTN: DELHD-FA

Fitzsimons Army Medical Center 80045
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Air Force 20332-5000
ATTN: USAF-LEEVN

Army National Guard 21010
ATTN: Environmental Div

NAVFAC Code 2042 22332-2300

DAMO-TRS 20310

HQ USAF/LEEV
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